APPENDIX O

SUPPORTING INFORMATION FOR NOISE

NOISE

Noise is sound that injures, annoys, interrupts or interferes with normal activities or otherwise diminishes the quality of the environment. It may be intermittent or continuous, steady or impulsive. It may be stationary or transient. Stationary sources are normally related to specific land uses (e.g., industrial plants or some military training activities). Transient noise sources move through the environment, either along relatively established paths (e.g., highways, railroads, and aircraft flying a specific flight track), or randomly (e.g., military training conducted in a training area). There is wide diversity in responses to noise that vary not only according to the type of noise and the characteristics of the sound source, but also according to the sensitivity and expectations of the receptor, the time of day, and the distance between the noise source (e.g., an aircraft) and the receptor (e.g., a person or animal).

The physical characteristics of noise, or sound, include its intensity, frequency, and duration. Sound is created by acoustic energy, which produces pressure waves that travel through a medium, like air, and are sensed by the eardrum. This may be likened to the ripples in water produced by a stone being dropped into it. As the acoustic energy increases, the intensity or amplitude of the pressure waves increase, and the ear senses louder noise.

Sound intensity varies widely (from a soft whisper to a jet plane or a gunshot) and is measured on a logarithmic scale to accommodate this wide range. The logarithm, and its use, is nothing more than a mathematical tool that simplifies dealing with very large and very small numbers. For example, the logarithm of the number 1,000,000 is 6, and the logarithm of the number 0.000001 is -6 (minus 6). Obviously, as more zeros are added before or after the decimal point, converting these numbers to their logarithms greatly simplifies calculations that use these numbers.

The frequency of sound is measured in cycles per second, or hertz (Hz). This measurement reflects the number of times per second the air vibrates from the acoustic energy. Low frequency sounds are heard as rumbles or roars, and high frequency sounds are heard as screeches.

Sound measurement is further refined through the use of “weighting.” The normal human ear can detect sounds that range in frequency from about 20 Hz to 15,000 Hz. However, all sounds throughout this range are not heard equally well. Therefore, through internal electronic circuitry, some sound meters are calibrated to emphasize frequencies in the 1,000 to 4,000 Hz range. The human ear is most sensitive to frequencies in this range. When measuring these sounds that continue over some time period (such as an aircraft overflight) with these instruments, the levels are termed “A-weighted” and are shown in terms of A-weighted decibels (dBA). Conversely, when describing large amplitude impulsive sounds of extremely short duration such as a gunshot, the total amount of acoustic energy created is an important consideration. Sounds of this nature are normally measured on the "C-weighted" scale, which gives nearly equal emphasis to sounds of most frequencies. Mid-range frequencies approximate the actual (unweighted) sound level, while the very low and very high frequency bands are significantly affected by C-weighting. When measured, these sounds are shown in terms of C-weighted decibels (dBC).

The duration of noise events and the number of times noise events occur are also important considerations in assessing noise impacts.

The word "metric" is used to describe a standard of measurement. As used in environmental noise analysis, there are many different types of noise metrics. Each metric has a different physical meaning or interpretation and each metric was developed by researchers attempting to represent the effects of environmental noise.

The metrics supporting the assessment of noise that would result from the conduct of the proposed training activities on and around Eglin AFB include both A- and C-weighted single event and time-averaged cumulative metrics. Each metric represents a "tier" for quantifying the noise environment and is briefly discussed below.

Sound Exposure Level

The Sound Exposure Level (SEL) metric combines the intensity and duration of a noise event into a single measure. It is important to note, however, that SEL does not directly represent the sound level heard at any given time, but rather provides a measure of the total exposure of the entire event. Its value represents all of the acoustic energy associated with the event, as though it was present for one second. For sound events that last longer than one second, the SEL value will be greater than the maximum noise level created by the event. For sound events that last less than one second, the SEL value will be less than the maximum acoustic pressure (dBP). The duration of many impulsive sounds, such as gunfire, is significantly less than one second. This, when coupled with the extremely low frequencies associated with such sounds that are repressed on the C-weighted scale means that the "sensed" or "perceived" sound may be 20 dB or more below the actual sound pressure level. Nevertheless, the SEL value is important because it is the value used to calculate other time-averaged noise metrics.

Time-Averaged Cumulative Day-Night Average Noise Metrics

The equivalent sound level (L_{eq}) is a metric reflecting average continuous sound. The metric considers variations in sound magnitude over periods of time, sums them, and reflects, in a single value, the acoustic energy present during the time period considered. Common time periods for averaging are 1, 8, and 24-hour periods.

The Day-Night Average Sound Level (L_{dn}) also sums the individual noise events and averages the resulting level over a specified length of time. Normally, this is a 24-hour period. Thus, like L_{eq}, it is a composite metric representing the maximum noise levels, the duration of the events, and the number of events that occur. However, this metric also considers the time of day during which noise events occur. This metric adds 10 dB to those events that occur between 10:00 P.M. and 7:00 A.M. to account for the increased intrusiveness of noise events that occur at night when ambient noise levels are normally lower than during the daytime. It should be noted that if no noise events occur between 10:00 P.M. and 7:00 A.M., the value calculated for L_{dn} would be identical to that calculated for a 24-hour equivalent noise level [$L_{eq(24)}$]. This cumulative metric does not represent the variations in the sound level heard. Nevertheless, it does provide an excellent measure for comparing environmental noise exposures when there are multiple noise events to be considered.

In this document, sound levels are considered as 1- and 24-hour equivalent sound levels [$L_{eq(1)}$ and $L_{eq(24)}$]. If applicable, the L_{dn} metric would be used in lieu of the $L_{eq(24)}$ metric. Average

Sound Level metrics are the preferred noise metrics of the Department of Housing and Urban Development (HUD), the Department of Transportation (DOT), the Federal Aviation Administration (FAA), the U.S. Environmental Protection Agency (USEPA), and the Veteran's Administration (VA). Scientific studies and social surveys have found that Average Sound Level metrics are the best measure to assess levels of community annoyance associated with all types of environmental noise. Therefore, their use is endorsed by the scientific community and governmental agencies (ANSI 1980, EPA 1974; FICUN 1980; U. S. Army 1994). In general, there are no recommended restrictions on any land uses at day-night average sound levels of 65 dBA or less (A-weighted).

Noise levels are directly related to traffic volumes, speed of traffic, proportion of heavy vehicles (one truck emits the equivalent noise of 28 to 60 cars), population density near roads, existence and effectiveness of noise barriers, and effectiveness of devices such as mufflers and quiet vehicles. The issue of noise is generally discussed in terms of the number or proportion of people affected. The findings of numerous research projects on the effects of noise and its wider repercussions indicate that an outdoor sound level of 65 decibels (dBA) (A-weighted metric) is "unacceptable," and an outdoor level of less than 55 dBA is desirable.

Calculating Population Noise

The equation used to estimate residential population noise is:

Ldn = 10Log(Population Density) + 22, where 22 is a constant (B. Wuest, pending).

An example of the application of this equation for predicting noise levels from Alternative 2 is provided IN Tables O-1 and O-2. Population density and subsequent noise for all alternatives were calculated in this fashion.

Tables O-1 and O-2 show calculations for Alternative 2, construction at Old Plew/New Plew and Capehart/Wherry Areas.

Table O-1. Population Density / Ambient Noise Estimates Eglin / Hurlburt Military Family Housing

Total Project		
Bedrooms	**Number of Units Constructed**	**Percent Distribution**
2	**1139**	57%
3	417	21%
4	432	21%
5	27	1%
Total Units:	**2015**	**100%**

Table O-2. Population Density/Ambient Noise Estimates Eglin / Hurlburt Military Family Housing

Location/Bedrooms	Number of Units	Percent Unit Distribution	Est. Pop/Unit	Total Estimated Population
Soundside Manor (3 units/acre)				
2	51.3	57%	3	153.9
3	18.9	21%	4	75.6
4	18.9	21%	5	94.5
5	0.9	1%	4	3.6
Totals	**90**	**100%**		**327.6**
			Area, In Acres	30
			Area, In Square Miles	0.046875
			Population Density per Square Mile	6988.8
			Estimated Sound Level	38.44402612
			Plus	22
			$L_{dn} = 10_{log}$(pop density) + 22 =	**60.44402612**
Soundside Manor 4 units/acre)				
2	68.4	57%	3	205.2
3	25.2	21%	4	100.8
4	25.2	21%	5	126
5	1.2	1%	4	4.8
Totals	**120**	**100%**		**436.8**
			Area, In Acres	30
			Area, In Square Miles	0.046875
			Population Density per Square Mile	9318.4
			Estimated Sound Level	39.69341349
			Plus	22
			$L_{dn} = 10_{log}$(pop density) + 22 =	**61.69341349**
Soundside Manor (6 units/acre)				
2	102.6	57%	3	307.8
3	37.8	21%	4	151.2
4	37.8	21%	5	189
5	1.8	1%	4	7.2
Totals	**180**	**100%**		**655.2**
			Area, In Acres	30
			Area, In Square Miles	0.046875
			Population Density per Square Mile	13977.6
			Estimated Sound Level	41.45432608
			Plus	22
			$L_{dn} = 10_{log}$(pop density) + 22 =	**63.45432608**

References:

ANSI, 1980. *Sound Level Descriptors for Determination of Compatible Land Use*. American National Standards Institute Standard ANSI S3.23-1980.

Federal Interagency Committee on Urban Noise (FICUN), 1980. Guidelines for Considering Noise in Land-Use Planning and Control. June 1980.

U.S. Army Center For Health and Preventative Medicine, 1994. Noise Zones for Installation Compatible Use Zones.

U.S. Environmental Protection Agency (USEPA), 1974. Information on Levels of Environmental Noise Requisite to Protect the Public Health and Welfare With an Adequate Margin of Safety. EPA Report 550/9-74-004.

Wuest, B., date pending. Reference will be provided later.

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